

Solar and meteorological measurements at Budapest-Lőrinc station, Hungary

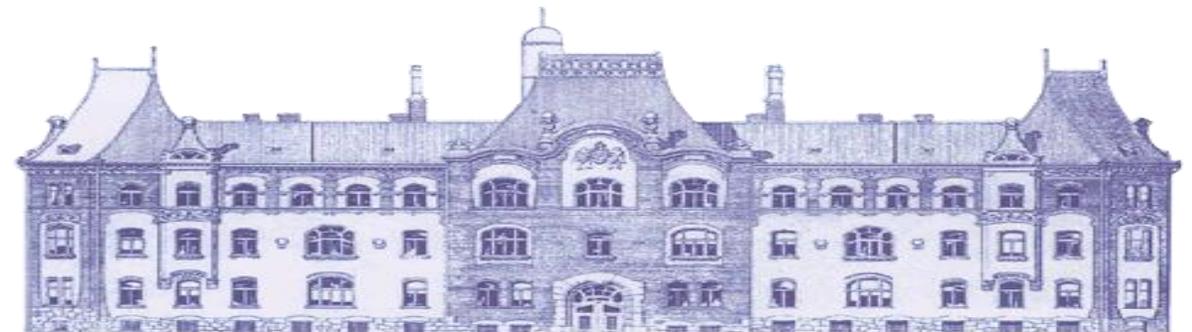
Proposal for BSRN station

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Alapítva: 1870



History of the site

- Founded: 1st May, 1952
- Solar radiation measurements started in 1967.
- Observations of total ozone has been started in 1969 with Dobson spectrophotometer.
- Budapest-Lőrinc is a WMO Regional Radiation Center from 1978.
- Calibration with Eppley HF absolute pyrhelimeter from 1980.
- Monitoring of UV-B radiation has been started in 1994.



Location

- Latitude: $47^{\circ}50'N$
- Longitude: $19^{\circ}05'E$
- Elevation: 139 m.a.s.l





Location





Geographical details of the site

- Continental climate with hot summers with low overall humidity levels but frequent rainshowers and cold snowy winters.
- Characterized by mean annual temperatures of 11.8 °C with the mean January temperature of -0.2 °C and the mean July temperature of 22.3 °C.
- Average annual rainfall is 516 mm.



- Kipp & Zonen CH1 pyrheliometer

2.1 ISO SPECIFICATIONS

Response time	95%	7 s
	99%	10 s
Zero offset: Caused by 5 K/H change in ambient temperature		3 W/m ² .
Non stability		< 1 % per year.
Non linearity		< 0.2 % (< 1000 W/m ²).
Spectral selectivity within 0.35 to 1.5 μm.		< 0.5 %.
Temperature response percentage deviation due to ambient temperature (relative to 20 °C)		< 1 %, -20 to +50. < 1.5 %, -40 to +70.
Tilt response		None.
Traceability		To WRR.

- Mounted on SOLYS 2 Suntracker
- Measurement interval: 2 sec
- (SolarSIM spectrophotometer)



- Kipp & Zonen CMP11 pyranometer
 - Ventillated

Specifications

Spectral range (50% points)	285 to 2800 nm
Sensitivity	7 to 14 $\mu\text{VW}/\text{m}^2$
Response time	< 5 s
Zero offset A	< 7 W/m^2
Zero offset B	< 2 W/m^2
Directional response (up to 80° with 1000 W/m^2 beam)	< 10 W/m^2
Temperature dependence of sensitivity (-10 °C to +40 °C)	< 1 %
Operational temperature range	-40 °C to +80 °C
Maximum solar irradiance	4000 W/m^2
Field of view	180 °

- Measurement interval: 2 sec





Diffuse solar radiation measurements

- Kipp & Zonen CMP11 pyranometer
 - Shaded and ventillated
- Uses ball shading arms on SOLYS 2 Suntracker.
- Measurement interval: 2 sec





Longwave downward radiation measurements

- Kipp & Zonen CGR4 pyradiometer
 - Ventillated

Specifications

Spectral range (50% points)	4.5 to 42 μm = 4500 to 42000 nm
Sensitivity	5 to 15 $\mu\text{V}/\text{W}/\text{m}^2$
Response time	18 s
Window heating offset	< 4 W/m^2
Zero offset B	< 2 W/m^2
Temperature dependence of sensitivity (-20 °C to +50 °C)	< 1 %
Operational temperature range	-40 to +80 °C
Net irradiance range	-250 to + 250 W/m^2
Field of view	180 °
Non-linearity	< 1 %

- Measurement interval: 2 sec



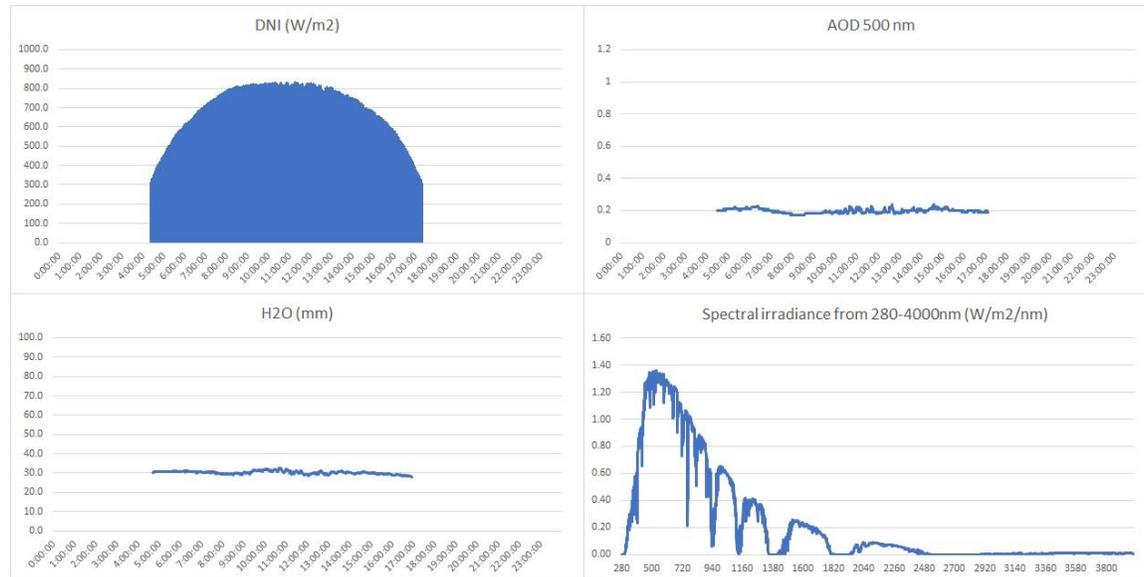
Additional measurements

- Total ozone and spectral UVB-UVA measurements with Brewer spectrophotometer
- Broadband UVB measurements: SolarLight UV-Biometer



Additional measurements

- Aerosol optical depth measurements with SP02 sunphotometer.
- Aerosol optical depth, total ozone and precipitable water vapor measurements with SolarSIM spectrophotometer.





Additional measurements

- Air pressure measurements: Vaisala PTB 100
- Air temperature and humidity measurements: Vaisala HMP 155
- Wind speed and direction
- Precipitation quantity and intensity
- Professional synoptic station
- (Traditional weather station)





Additional measurements

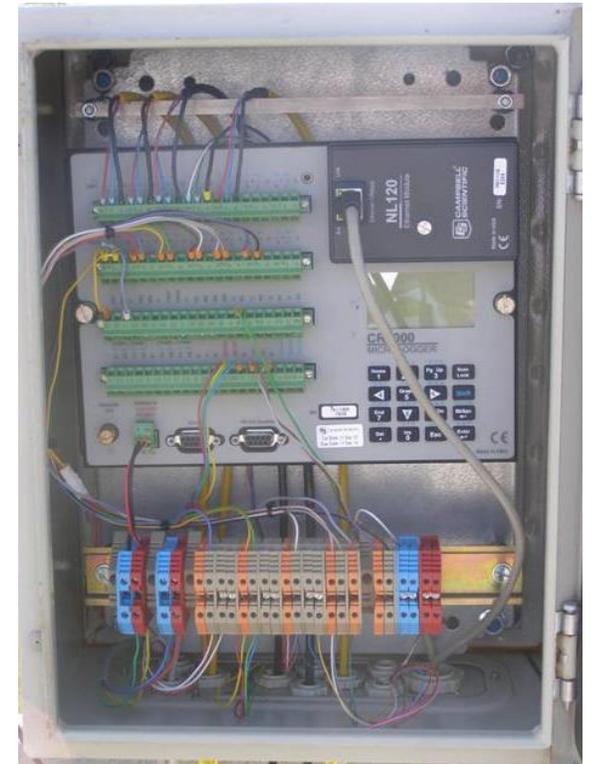
- Radiosonde launching twice a day (UTC 00 and 12)
- Cloud heights, cloud coverage, height of the mixture layer and boundary layer measurements: Lufft CHM 15k





Data collection and quality checking

- Solar radiation data measured using Campbell Scientific CR3000 data logger.
- All other instrument data retrieved via Hungarian Meteorological Service own developed datalogger called ODL.
- Real time data available for inspection
- **Quality checks:**
 - Operated by working instructions of ISO quality control/assurance system
 - Data outside expected limits
 - Missing data points





Calibrating facilities

- For calibration of the shortwave sensors a reference set is used with the next components:
 - Kipp&Zonen BD solar tracker;
 - HF19746 primary standard pyrhelimeter;
 - 2 secondary standard Kipp&Zonen CH1 pyrhelimeters;
 - Hukseflux SR25 pyranometer to measure the reference diffuse radiation;
 - Primary standard CMP11 pyranometer (ventilated);
 - Agilent 34970A Multimeter and Campbell Scientific CR3000 data logger with special program to control the calibration of reference set.

WRR correction factor of HF 19746 absolute pyrhelimeter



- For calibration of the longwave sensors, modified reference Eppley PYR and Kipp&Zonen CGR4 pyrgeometers are used (last calibration of both was in WRC 09.2014)
- Operational calibration of sensors: every year





Summary

Which data can we send?

- **Obligatory:** direct, diffuse, global and longwave downward radiation, air temperature, relative humidity, air pressure.
- **Ancillary:** shortwave upward, longwave upward and UV radiation, synoptic observations, upper air soundings, ceilometer data.



Summary

- Budapest-Lőrinc site represents Central-Europe continental climate with long warm period. The nearest BSRN station is 480 km away in Austria.
- High quality instrumentation and data acquisition.
- WMO Regional Radiation Center.
- Many additional measurements.
- In the past, Budapest-Lőrinc's site had been given provisional acceptance, but unfortunately, data sendings has not been realized.



Thank you!



If you have any question, you can find me by the site's poster.